PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

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Date of mailing (day/month/year)
19 July 2000 (19.07.00)

Applicant's or agent's file reference
PAC-006-WO

IMPORTANT NOTIFICATION

International application No.
PCT/DE99/02554

International filing date (day/month/year)
18 August 1999 (18.08.99)

1. The following indications appeared on record concerning:

[X] the applicant [X] the inventor [ ] the agent [ ] the common representative

Name and Address
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State of Residence: DE
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2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[ ] the person [ ] the name [X] the address [X] the nationality [ ] the residence

Name and Address
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Germany

State of Nationality: IR
State of Residence: DE
Telephone No.:
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3. Further observations, if necessary:

4. A copy of this notification has been sent to:

[X] the receiving Office
[ ] the International Searching Authority
[X] the International Preliminary Examining Authority
[ ] the designated Offices concerned
[X] the elected Offices concerned
[ ] other:

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer
Jocelyne Rey-Millet

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PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents
United States Patent and Trademark Office
Box PCT
Washington, D.C.20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 25 April 2000 (25.04.00)	
International application No. PCT/DE99/02554	**Applicant's or agent's file reference** PAC-006-WO
International filing date (day/month/year) 18 August 1999 (18.08.99)	**Priority date** (day/month/year) 25 August 1998 (25.08.98)
Applicant MOMENI, Kaveh et al	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

24 March 2000 (24.03.00)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO
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Authorized officer

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VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS

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PCT

INTERNATIONALER RECHERCHENBERICHT

(Artikel 18 sowie Regeln 43 und 44 PCT)

Aktenzeichen des Anmelders oder Anwalts	WEITERES VORGEHEN	siehe Mitteilung über die Übermittlung des internationalen Recherchenberichts (Formblatt PCT/ISA/220) sowie, soweit zutreffend, nachstehender Punkt 5
PAC-006-WO		
Internationales Aktenzeichen	Internationales Anmeldedatum *(Tag/Monat/Jahr)*	(Frühestes) Prioritätsdatum *(Tag/Monat/Jahr)*
PCT/DE 99/ 02554	18/08/1999	25/08/1998
Anmelder		
PAC TECH-PACKAGING TECHNOLOGIES GMBH et al.		

Dieser internationale Recherchenbericht wurde von der Internationalen Recherchenbehörde erstellt und wird dem Anmelder gemäß Artikel 18 übermittelt. Eine Kopie wird dem Internationalen Büro übermittelt.

Dieser internationale Recherchenbericht umfaßt insgesamt 3 Blätter.

[X] Darüber hinaus liegt ihm jeweils eine Kopie der in diesem Bericht genannten Unterlagen zum Stand der Technik bei.

1. **Grundlage des Berichts**

   a. Hinsichtlich der **Sprache** ist die internationale Recherche auf der Grundlage der internationalen Anmeldung in der Sprache durchgeführt worden, in der sie eingereicht wurde, sofern unter diesem Punkt nichts anderes angegeben ist.

   [ ] Die internationale Recherche ist auf der Grundlage einer bei der Behörde eingereichten Übersetzung der internationalen Anmeldung (Regel 23.1 b)) durchgeführt worden.

   b. Hinsichtlich der in der internationalen Anmeldung offenbarten **Nucleotid- und/oder Aminosäuresequenz** ist die internationale Recherche auf der Grundlage des Sequenzprotokolls durchgeführt worden, das

   [ ] in der internationalen Anmeldung in Schriftlicher Form enthalten ist.

   [ ] zusammen mit der internationalen Anmeldung in computerlesbarer Form eingereicht worden ist.

   [ ] bei der Behörde nachträglich in schriftlicher Form eingereicht worden ist.

   [ ] bei der Behörde nachträglich in computerlesbarer Form eingereicht worden ist.

   [ ] Die Erklärung, daß das nachträglich eingereichte schriftliche Sequenzprotokoll nicht über den Offenbarungsgehalt der internationalen Anmeldung im Anmeldezeitpunkt hinausgeht, wurde vorgelegt.

   [ ] Die Erklärung, daß die in computerlesbarer Form erfaßten Informationen dem schriftlichen Sequenzprotokoll entsprechen, wurde vorgelegt.

2. [ ] **Bestimmte Ansprüche haben sich als nicht recherchierbar erwiesen** (siehe Feld I).

3. [ ] **Mangelnde Einheitlichkeit der Erfindung** (siehe Feld II).

4. Hinsichtlich der **Bezeichnung der Erfindung**

   [X] wird der vom Anmelder eingereichte Wortlaut genehmigt.

   [ ] wurde der Wortlaut von der Behörde wie folgt festgesetzt:

5. Hinsichtlich der **Zusammenfassung**

   [X] wird der vom Anmelder eingereichte Wortlaut genehmigt.

   [ ] wurde der Wortlaut nach Regel 38.2b) in der in Feld III angegebenen Fassung von der Behörde festgesetzt. Der Anmelder kann der Behörde innerhalb eines Monats nach dem Datum der Absendung dieses internationalen Recherchenberichts eine Stellungnahme vorlegen.

6. Folgende Abbildung der **Zeichnungen** ist mit der Zusammenfassung zu veröffentlichen: Abb. Nr. 1

   [X] wie vom Anmelder vorgeschlagen [ ] keine der Abb.

   [ ] weil der Anmelder selbst keine Abbildung vorgeschlagen hat.

   [ ] weil diese Abbildung die Erfindung besser kennzeichnet.

A method and a device for placing and re-melting shaped parts of solder material

The present invention relates to a method for placing and re-melting a multitude of shaped parts of solder material on a bond pad arrangement of a substrate, said bond pad arrangement comprising a multitude of bond pads, and for subsequent re-melting of the shaped parts of solder material on the bond pads. Furthermore, the present invention relates to devices suitable for implementing this method, according to the preambles of claims 9 and 14.

Methods of the type mentioned above are used for example in so-called wafer bumping, in the production of so-called chip-size packages, or in the production of ball grid arrays. Basically, the above-mentioned methods involve the production of a multitude of uniformly shaped bond pad metallisation areas or contact metallisation areas in a specified arrangement, on a substrate surface. To this effect, the following methods have been used up to now. In the first method, placement or arrangement of solder material deposits on the bond pads takes place as part of an individual placement method, and subsequent re-melting takes place by a separate application of heat energy, for example laser energy, to the solder material deposits or to shaped parts of solder material. In the second method, for example in a mask application process, solder material deposits are applied as a paste-like material, and subsequent re-melting is carried out in an oven, at the same time for all the solder material deposits.

The first method is particularly advantageous in that as a result of individual application of thermal energy to the solder material deposits or to the shaped parts of solder material, in particular in the case where laser energy is used, the substrate is exposed to as little thermal load as possible. However, this method is also correspondingly slow in its

implementation. The second method, in particular due to the rapidly progressing re-melting process, makes it possible to achieve a large throughput with accordingly large numbers being produced. However, the implementation of such a method is associated with considerable production costs, in particular due to the considerable expense of the equipment required. Furthermore, depending on the type of the substrate to be treated in this way, problems will be encountered due to the substantial thermal loads experienced.

WO 98/12738 describes a method in which an aperture screen is arranged above a substrate which comprises a bond pad arrangement, such that the apertures present in the aperture screen correspond to the bond pads of the substrate. Subsequently, by means of a vacuum pipette, individual shaped parts of solder material are inserted in the apertures of the aperture screen. After the arrangement has been preheated in an oven, the shaped parts of solder material are melted on by application of xenon light which is projected from the side of the aperture screen facing away from the substrate.

It is thus the object of the present invention to propose a method of the type mentioned in the introduction, and to propose a device which is suitable for implementing such a method, which device and method make it possible to place and subsequently re-melt a multitude of shaped parts of solder material on bond pads of a substrate as economically as possible while at the same time keeping thermal exposure of the substrate as low as possible.

This object is met by a method with the characteristics of claim 1, and by a device with the characteristics of claim 9 or 14.

In the method according to the invention, first a template device which comprises a multitude of template apertures for accommodating shaped

parts of solder materials, is arranged opposite a substrate comprising a bond pad arrangement such that the shaped parts of solder material are associated with the individual bond pads, followed by scanning of the template aperture with an optical scanning device for detecting shaped parts of solder material, and then followed by application of laser energy, from a laser device which is arranged at the rear of the template device, to the shaped parts of solder material accommodated in the template apertures, such that laser energy is applied through the template device, to the shaped parts of solder material.

This makes it possible to detect any defective spots very early, i.e. prior to any quality assurance test which may take place after the re-melting action. Furthermore, the laser device can be made to be triggered only if a shaped part of solder material is present at the particular bond pad, thus preventing any thermal damage to the substrate due to the bond pad being directly exposed to laser energy.

Thus the process according to the invention combines a template method which is suitable for carrying out a particularly time-saving placement action, with a laser re-melting process which, from the point of view of thermal load, is particularly gentle on the substrate.

In a particularly preferred variant of the method, singling-out, which is necessary for applying the individual shaped parts of solder material, takes place in the template device itself, from a quantity of shaped parts of solder material accommodated in the template device, by filling of the template apertures which are arranged in an aperture screen of the template device. In this variant of the method, the template device itself serves as a reservoir for the shaped parts of solder material, thus obviating the need for a separate feed device for feeding shaped parts of solder material to the template device.

In a variant of the method which is also very advantageous, singling out of the shaped parts of solder material by the template device takes place by removing shaped parts of solder material from a quantity of shaped parts of solder material arranged outside the template device, such that during removal, the template device's template apertures, which are arranged in an aperture screen, are filled.

In this variant, the template device itself serves as a removal device, so that there is no need to provide a separate device for supplying shaped parts of solder material to the template device and for removing shaped parts of solder material from said template device.

It has also been shown to be particularly advantageous if application of laser energy to the shaped parts of solder material takes place via the optical scanning device which is already being used for detecting shaped parts of solder material.

If that variant of the method is used where, as explained above, the template device itself serves as a reservoir for the shaped parts of solder material, it is advantageous if filling of the template apertures arranged in an aperture screen of the template device, takes place by means of a filling chamber which can be moved over the aperture screen and which is open towards said aperture screen.

A further advantageous option when realising the variant of the method according to the invention where the template device itself serves as a reservoir for the shaped parts of solder material, consists of filling the template apertures which are arranged in an aperture screen of the template device by means of a paddle-wheel device which can be moved parallel to the surface of the aperture screen, rotating on its movement axis.

CLAIMS

1. A method for placing a multitude of shaped parts of solder material on a bond pad arrangement of a substrate, said bond pad arrangement comprising a multitude of bond pads, and for subsequent re-melting of the shaped parts of solder material on the bond pads;
characterised by
the following process steps:
   - Arrangement of a template device (21, 40, 51, 56, 65, 75) comprising a multitude of template apertures (27, 48, 61, 70) for accommodating shaped parts of solder material (20) opposite a substrate (23, 49, 64) comprising a bond pad arrangement (29), such that the shaped parts of solder material are associated with the individual bond pads (28, 50, 63);
   - Scanning of the template apertures (27, 48, 61, 70) with an optical scanning device (32) for detecting shaped parts of solder material (20);
   - Application of laser energy to the shaped parts of solder material (20) accommodated in the template apertures (27, 48, 61, 70) using a laser device (39) arranged at the rear of the template device (21, 40, 51, 56, 65, 75) such that said laser energy is applied to the shaped parts of solder material through the template device.

2. The method according to claim 1,
characterised in that,
in the template device (40, 51), singling out of the shaped parts of solder material (20) from the bulk of shaped parts of solder material accommodated in the template device, takes place by filling the template apertures (48) arranged in an aperture screen (41).

3. The method according to claim 1,
characterised in that,
by means of the template device (56, 65), singling out of the shaped parts of solder material (20) from a quantity (57) of shaped parts of solder material outside the template device, takes place by filling the template apertures (60, 70) which are arranged in an aperture screen (58, 66).

4. The method according to claim 3,
characterised in that,
application of laser energy to the shaped parts of solder material (20) takes place via the optical scanning device (32).

5. The method according to claim 2,
characterised in that,
filling of the template apertures (48) arranged in the aperture screen (41) of the template device (40) takes place by means of a filling chamber (47) which can be moved over the aperture screen, said filling chamber being open towards the aperture screen.

6. The method according to claim 2,
characterised in that,
filling of the template apertures (48) arranged in the aperture screen (41) of the template device (51) takes place by means of a paddle-wheel device (52) which is guided parallel to the surface of the aperture screen, rotating on its movement axis.

7. The method according to claim 3,
characterised in that,

filling of the template apertures (60, 70) arranged in the aperture screen (58, 66) of the template device (56, 65), takes place by means of pressure below atmospheric.

8. The method according to one or several of the preceding claims, characterised in that, the pressure exerted on the shaped parts of solder material (20) accommodated in the template apertures (70) for establishing contact with the bond pads (63) is generated by means of pressure above atmospheric.

9. A device for placing a multitude of shaped parts of solder material (20) on a bond pad arrangement (29) of a substrate (49), said bond pad arrangement comprising a multitude of bond pads (50), and for subsequent re-melting of the shaped parts of solder material on the bond pads, with an aperture screen (41) for exposed accommodation of simplified shaped parts of solder material in template apertures (48) of the aperture screen (41) allocated to individual bond pads (50) of the bond pad arrangement (29), , such that the shaped parts of solder material can be exposed to laser energy from the rear by means of a laser device (39), characterised in that, the aperture screen (41) is designed as a container wall of a template device (40, 51) which is used to transfer the shaped parts of solder material on the bond pad arrangement (29) and which comprises a container (47, 51) for holding a quantity of shaped parts of solder material, with the aperture screen comprising a singling-out device (47, 52).

10. The device according to claim 9, characterised in that,

the singling-out device (47, 52) is designed so that it can be moved over the aperture screen (41).

11. The device according to claim 10,
characterised in that,
the singling-out device is a filling chamber (47) which can be moved over the aperture screen (41), said filling chamber being open towards the aperture screen.

12. The device according to claim 10,
characterised in that,
the singling-out device is a paddle-wheel device (52) which can be moved over the aperture screen (41), with radially open transport compartments delimited by paddles (54) of the paddle-wheel device.

13. The device according to one or several of claims 9 to 12,
characterised in that,
the singling-out device (47, 52) is accommodated in a closed space (45) which is formed by the template device (40, 51) whose rear wall (42) which is opposite the aperture screen (41) is made so as to be transparent.

14. A device for placing a multitude of shaped parts of solder material (20) on a bond pad arrangement of a substrate (64), said bond pad arrangement comprising a multitude of bond pads (63), and for subsequent re-melting of the shaped parts of solder material on the bond pads, with an aperture screen (58, 66) which comprises a multitude of template apertures (60, 70) for accommodating shaped parts of solder material,
characterised in that,

the aperture screen (58, 66) serves as a housing part of a template device (56, 65) configured as a singling-out device, with the template device (56, 65) comprising a transparent rear wall (67) arranged opposite the aperture screen.

15. The device according to claim 14, characterised in that, the diameter of the template apertures (60) formed in the aperture screen (58) is smaller than the smallest diameter of the shaped parts of solder material (20).

16. The device according to claim 14, characterised in that, the diameter of the template apertures (70) formed in the aperture screen (66) is larger than the largest diameter of the shaped parts of solder material (20), and that the distance a between the aperture screen and the rear wall (67) is smaller than the smallest diameter d of the shaped parts of solder material (20).

17. The device according to one or several of claims 9 to 16, characterised in that, the wall structure of the aperture screen (24, 41, 58, 66, 74) and/or the sidewalls (46) of the filling chamber (47), which can be moved over the aperture screen, is flexible across the area of the aperture screen.

18. The device according to claim 17, characterised in that, the wall structure comprises at least three layers, with a flexible compression layer (79, 82) sandwiched between two wear-resistant surface layers (77, 78, 80, 81).

19. The device according to claim 18,
characterised in that,
the compression layer (79, 82) is made from a plastic material, and
the surface layers (77, 78, 80, 81) are made from metal.